PATENT SPECIFICATION

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PROVISIONAL SPECIFICATION

Improvements relating to Reciprocating Engines

I, GILBERT EDGAR MANLEY, of Norton Curlieu, in the County of Warwick, a British Subject, do hereby declare the nature of this invention to be as follows:—

This invention has reference to improvements relating to reciprocating engines and is concerned particularly but not exclusively with reciprocating engines of the type in which the pistons move with a simple harmonic motion.

The present invention has for its primary object to provide a new or improved means of balancing dynamically an engine of the aforesaid type.

Accordingly the invention consists of a new or improved reciprocating engine in which a proportion of the out of balance forces are counteracted by a balancing mass associated with the rotatable main shaft or shafts and in which the remainder of the out of balance forces are neutralised by an additional rotary balancing means driven from said shaft or shafts which is arranged to exert a force which is always equal and opposite to the said remaining out of balance force.

The invention also resides in a new or improved reciprocating engine arranged and adapted for operation substantially as will be described hereinafter.

An embodiment of the invention will now be described in its application to a horizontally opposed two cylinder internal combustion engine adapted to operate according to the two stroke cycle with a simple harmonic motion.

According to the said embodiment of the invention the ends of the piston rods opposite to those carrying the pistons are attached in parallel relationship to the opposite sides of a link having therein a slot the axis of of which is at right angles to the mean axis of thrust of the pistons.

Adapted for a sliding movement within the said slot is a block bored to receive a crank pin formed between crank cheeks situated on either side of the slotted link. Equal balancing masses are situated on the two crank cheeks opposite the points of attachment of the crank pin of such magnitude that the combined force exerted by the two masses is equal to one half the maximum out of balance force exerted by the reciprocating assembly when at the extremities of its stroke. Each crank cheek is formed with a section of main shaft, one of which shafts would normally constitute the output shaft.

Fixed on the main shafts on either side of the crank and slot mechanism are pinions each of which is associated with a group of oppositely disposed pinions hereinafter termed the balancing pinions so that the said balancing pinions are rotated in an opposite direction to the main shafts.

The balancing pinions aforesaid comprise balancing masses which, in the aggregate, produce a force of one half of the maximum out of balance force arising from the reciprocating assembly. The groups of balancing pinions are so phased in relation to the crank mechanism that the resultant of the forces exerted by them acts in the same line and in the same direction as that due to the crank cheek balance weights when the reciprocating assembly is at the extremity of its stroke and in the same line but in opposite direction thereto when the said assembly is at mid-stroke. In other words when the reciprocating assembly is at the extremities of its stroke one half of the force required to balance it is provided by the crank cheek balance weights and the other half by the aggregate effect of the balance pinions, while at mid-stroke, when no out of balance forces arises from the reciprocating assembly the transverse force due to the crank cheek balance weights is exactly counteracted by that arising from the balancing pinions. At all situations intermediate between those considered above similarly perfect instantaneous dynamic balance is achieved.

It will be appreciated that the invention is applicable to reciprocating engines of the type specified having one or any number of cylinders.

Further it will be appreciated that any number of balancing pinions may be used provided the sum of the individual balancing forces produced thereby is equal to the proportion of the out of balance force required to be neutralised by said balancing pinions.

Dated this 19th day of February, 1948.

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Agent for Applicant.

COMPLETE SPECIFICATION

Improvements relating to Reciprocating Engines

I, GILBERT EDGAR MANLEY, of Norton Curlieu, in the County of Warwick, a British Subject, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement: —

This invention relates to reciprocating engines of the type in which the piston or each piston moves with a simple harmonic motion, and is connected to a crank by a cross head.

The invention has for its object to provide means for balancing an engine of the said type.

The invention comprises an engine of the type specified having combined therewith rotary balancing masses so arranged that the centrifugal forces associated with them act in opposition to the momentum of the reciprocatory parts when the latter are at either end of their movement, and act in mutual opposition when the reciprocatory parts are in the mid position of their movement.

In particular the invention comprises an engine of the type specified having in combination therewith a balancing mass or masses associated with the crank, at least one pair of equal gear wheels one of which is driven by the crank, and a balancing mass associated with the other gear wheel, the arrangement being such that the centrifugal forces associated with the balancing masses act in opposition to the momentum of the reciprocatory parts when the latter are at either end of their movement, and act in mutual opposition when the reciprocatory parts are in the mid position of their movement.

The invention will now be described with reference to the accompanying drawings wherein: —

Figures 1—4 are diagrammatic representations illustrative of the principles underlying the invention and showing the invention as applied to a horizontally opposed two-cylinder internal combustion engine adapted to operate according to the two-stroke cycle with a simple harmonic motion showing the parts in the positions occupied during varying stages of the stroke of the pistons.

Figure 5 is a view partly in elevation but mainly in vertical section of a horizontally opposed two-cylinder internal combustion engine operating in accordance with the arrangement illustrated diagrammatically in Figures 1—4 and Figure 6 is a fragmentary view in section of part of the engine illustrated in Figure 5, the section being taken on the plane indicated by the line 5, 5 Figure 5 looking in the direction of the arrows.

Referring to Figures 1—4, the ends of the piston rods 10 opposite to those carrying the pistons 11 are attached to the opposite sides of a crosshead 12 having therein a slot 12*a* the major axis of which is at right angles to the main axis of the pistons 11.

Adapted for a sliding movement within the said slot 12*a* is a crank pin 14 connecting crank cheeks 15 situate on either side of the slotted crosshead 12.

At the ends of the crank cheeks 15 are provided counterweights 16 of such magnitude that the combined centrifugal force exerted by the two masses 16 is equal to one half the maximum out of balance force exerted by the reciprocating assembly when at the extremities of its stroke.

Each crank cheek 15 is formed with a section of a main shaft 17 one of which shafts would normally constitute the output shaft.

Fixed on the main shafts 17 on either side of the crank cheeks 15 and the crosshead 12 and at equal distances therefrom are pinions 18 each of which is associated with a group of oppositely disposed and equal pinions 19 hereinafter termed the balancing pinions 19 so that the said balancing pinions 19 are rotated in an opposite direction to the main shafts 17.

The balancing pinions 19 aforesaid incorporate equal and similarly placed balancing weights 191 which in the aggregate produce a centrifugal force of one half of the maximum out of balance force arising from the reciprocating assembly.

The masses 191 and 16 are so phased that the centrifugal forces exerted by them act in the same direction and in opposition to the momentum of the reciprocating assembly when the latter is at either extremity of its stroke, see Figures 2 and 4, and in opposite directions when the said assembly is at mid-stroke, see Figures 1 and 3.

In the embodiment of the invention as shown in Figures 5 and 6 only two balancing pinions 19 are employed on each side of the crank cheeks 15. The balancing pinions 19

mesh with the pinions 18 mounted on the two sections of the main shaft 17 whilst the axles 20 on which the said balancing pinions 19 are mounted also have freely mounted thereon balancing masses 191 which are connected to the balancing pinions 19 by pegs 192.

Each piston rod 10 is associated at the inner end with the respective sides of a cross-head 12, and slippers 21 slidable on the edge parts of the link 12 serve to connect the part 12 to the cranks 15, the latter being interconnected by a pin 14.

It will be appreciated that the invention is applicable to reciprocating engines of the type specified having one or any number of cylinders.

Further it will be appreciated that any number of balancing masses 191 may be used provided the sum of the individual forces produced thereby is equal to the proportion of the out of balance force required to be neutralised by said masses 191.

Moreover it should be appreciated that instead of employing similar rotary assemblies of balancing masses arranged symmetrically on either side of the axis of reciprocation, a single assembly driven from the main shaft may be employed.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is: —

1. An engine of the type specified having combined therewith rotary balancing masses so arranged that the centrifugal forces associated with them act in opposition to the momentum of the reciprocatory parts when the latter are at either end of their movement, and act in mutual opposition when the reciprocatory parts are in the mid position of their movement.

2. An engine of the type specified having in combination therewith a balancing mass or masses associated with the crank, at least one pair of equal gear wheels one of which is driven by the crank, and a balancing mass associated with the other gear wheel, the arrangement being such that the centrifugal forces associated with the balancing masses act in opposition to the momentum of the reciprocatory parts when the latter are at either end of their movement, and act in mutual opposition when the recipricatory parts are in the mid position of their movement.

3. An engine of the type specified having a balancing mass or masses associated with the crank, a gear wheel at each side of the crank, a pair of gear wheels each equal in diameter to and engaging with opposite sides of the said wheel, and a balancing mass associated with each of the said other wheels, the arrangement being such that the centrifugal forces associated with the balancing masses all act in opposition to the momentum of the reciprocatory parts when the latter are at either end of their movement, and the centrifugal forces of the masses associated with the gear wheels act in opposition to and are equal to the centrifugal force of the mass or masses associated with the crank when the reciprocatory parts are in the mid position of their movement.

4. Means for balancing a reciprocatory engine of the type specified, comprising the combination and arrangement of parts, substantially as described and as illustrated by the accompanying drawings.

Dated this 16th day of March, 1949.

MARKS & CLERK.

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FIG.1.

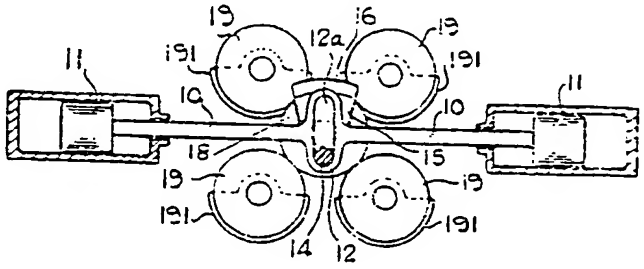


FIG.2.

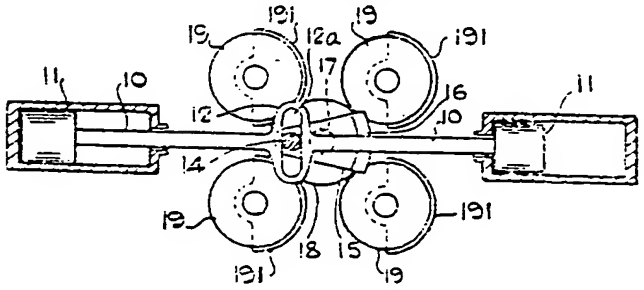


FIG.3.

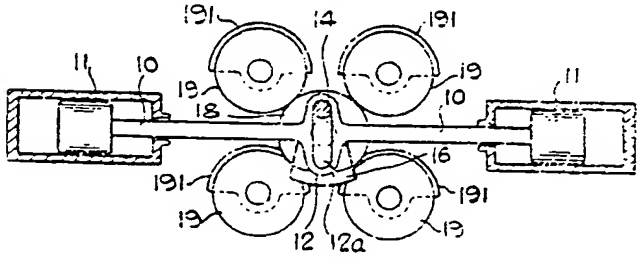
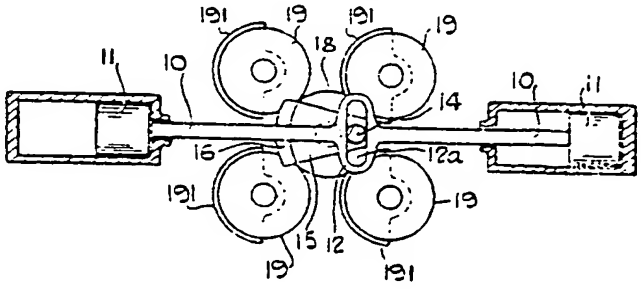


FIG.4.



[This Drawing is a reproduction of the Original on a reduced scale.]

FIG.5.

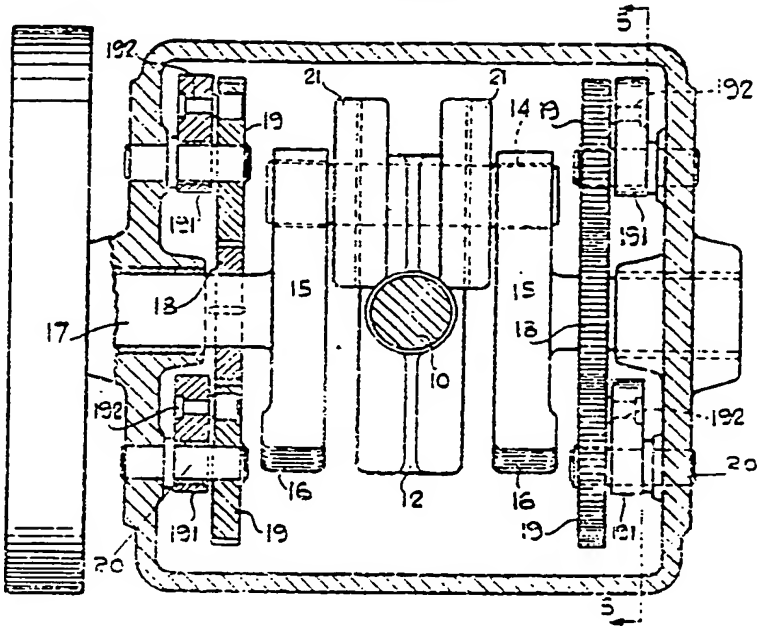


FIG.6.

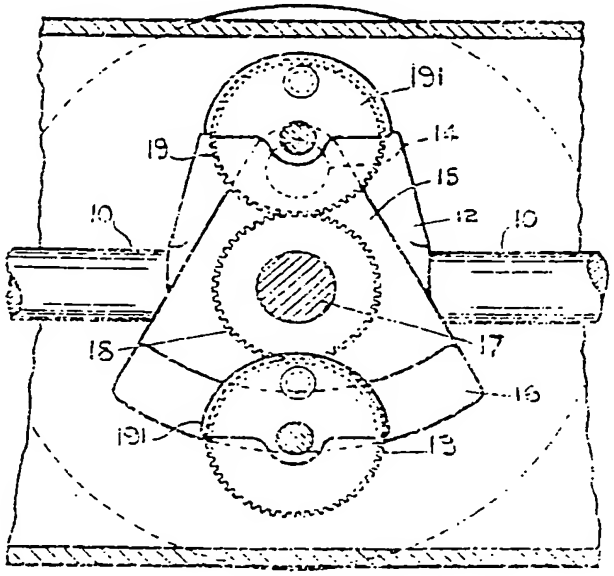


FIG.1.

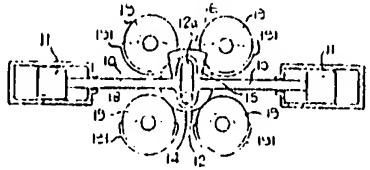


FIG.2.

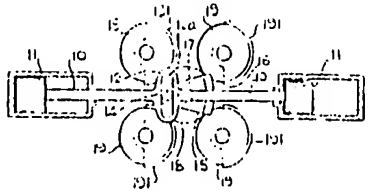


FIG.3.

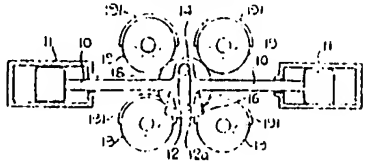


FIG.4.

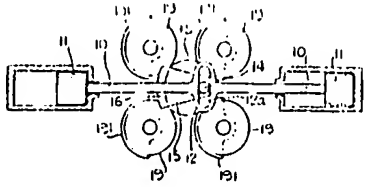


FIG.5.

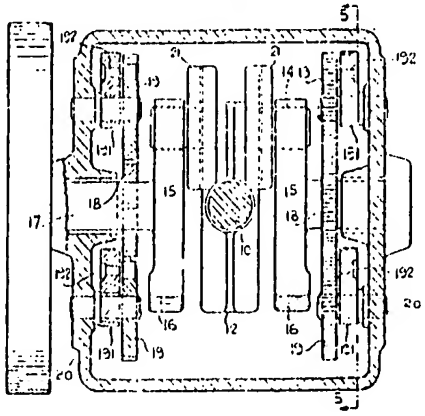


FIG.6.